

New Antineutrino Spectra for Plutonium and Uranium

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There is considerable interest by the International Atomic Energy Agency in determining the feasibility of using antineutrino monitoring of the plutonium (Pu) content of reactors. In the present project we have improved antineutrino spectra from thermal fission of ^{235}U and ^{239}Pu needed for these feasibility studies.

The total beta spectrum seen in fission arises from thousands of beta end-points from over 1000 fission product nuclei. Here beta spectra for Pu and U were calculated using the appropriate individual spectra data

from ENDFB-VI, as updated by Katakura and England. In these data, beta spectra are represented using known end-point energies and supplemental by continuous spectra from the gross theory of beta decay. All available beta spectra have been processed to 14.9 MeV using 158 energy bins. These spectra were then combined with the ENDFB-VI updated cumulative fission yields to calculate equilibrium fission product beta spectra for the two fission systems Pu and U. Each of these was fitted using 48 fictitious end-point energies with high precision. The antineutrino spectra associated with the calculated beta spectra could then be calculated from the fitted 48 end points.

Figure 1 compares the aggregate calculated beta and neutrino spectrum for ^{235}U with the experimentally determined spectrum of Keyser and the equilibrium spectrum calculated by Vogel. The agreement between the measured and calculated beta spectra is exceptional. Figure 2 shows the corresponding beta and antineutrino spectrum for ^{239}Pu . These newly calculated spectra for ^{235}U and ^{239}Pu are the first available spectra out to such large energies (15 MeV), and they span 8 orders of magnitude.

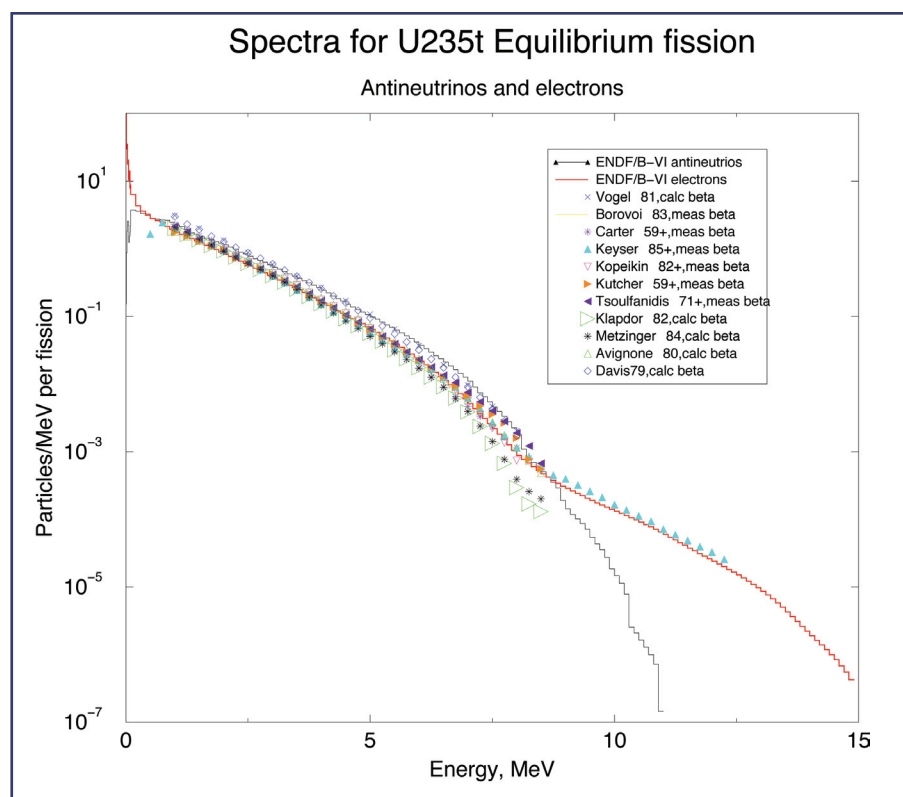


Figure 1—
Spectra for U235t
Equilibrium fission.

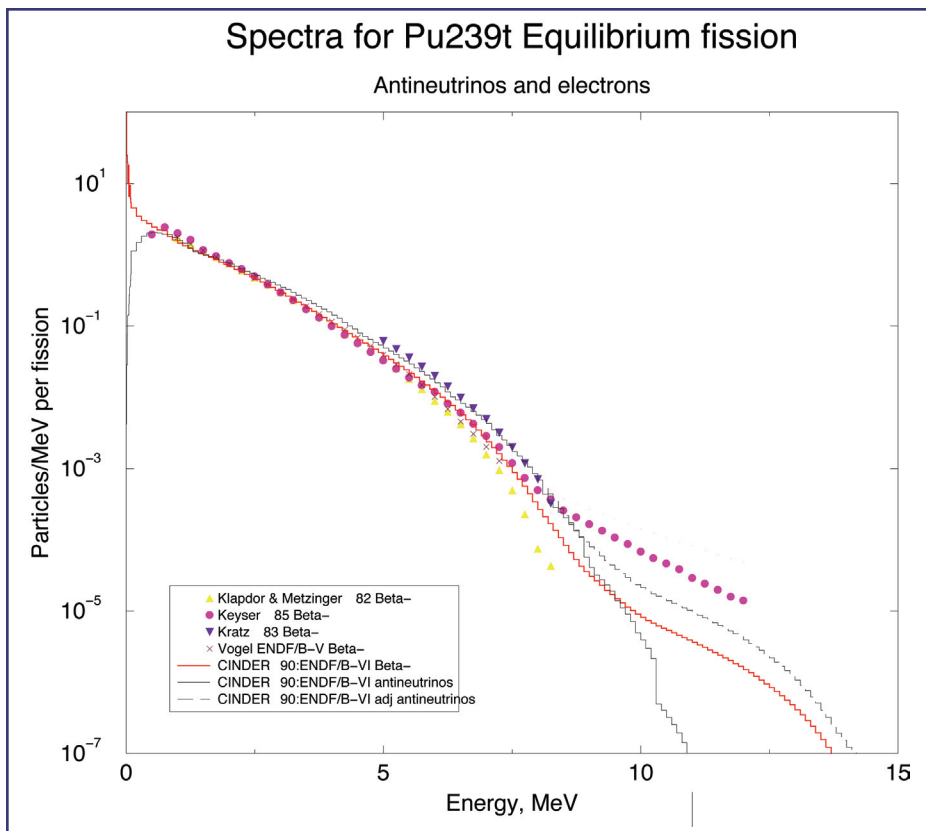


Figure 2—
Spectra for Pu239t
Equilibrium fission.

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Acknowledgements

We would like to acknowledge the Laboratory
Directed Research and Development Program for
financial support.